

the surrounding matter, resisted the decomposition which has attacked the latter; and now they stand out like roots or trees. Mr. Darwin found many land shells round them, which quite bears out his view of their sub-ærial origin. But at Cape Grant nothing of the kind is visible. The so-called roots may often be traced many feet through different strata, and are quite as thick at the bottom as at the top. Besides, there is evident proof that there has been nothing but upheaval since the trap was deposited; and as a great part of the crag, even now, lies beneath the sea, there has been no opportunity for trees to grow where the supposed roots are found. I believe such formations as the crag are common on the whole coast westward as far as Western Australia; and it is just what we might expect to follow the extension of a great coral deposit before the site of the coral reef was raised into dry land.

I have now described the tertiary rocks at Portland Bay. My object has been only to draw attention to the rocks that are there visible, in order that future investigators may have a clear idea of their sequence and nature, in any examination they may make of the locality.

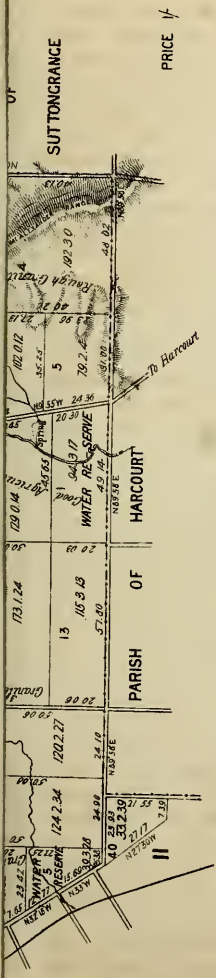
ART. XVII.—*On a new Photo-Lithographic Process.* By
JOHN WALTER OSBORNE, Esq.

(With an illustrative Map.)

[Read before the Institute 30th November, 1859.]

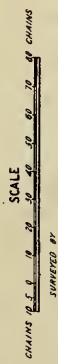
PHOTOGRAPHIC science has of late years made such astonishing progress, that it has stimulated the inventive genius of scientific men, awakening in them the very natural wish to make its many advantages applicable to the several graphic arts. The result has been the more or less perfect development of a number of processes bearing directly upon the reproduction of works of art.

Thus the application of photography to engravings has been the object of Mr. Fox Talbot's exertions; Niepce de St. Victor and Mr. Pretsch are also working in the same direction; while several gentlemen, of whom I shall subse-



Country Lots

PARISHES OF RAVENSWOOD & MANDURANG.



J. J. BREEN
ASSISTANT SURVEYOR
Photographed by J. W. Osborne
at the Crown Lands Office

SPECIMEN OF PHOTO-LITHOGRAPHY.



Country Lots

PARISHES OF RAVENSWOOD & MANDURANC.

SCALE
MILES 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100
FURLONGS 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000 2100 2200 2300 2400 2500 2600 2700 2800 2900 3000 3100 3200 3300 3400 3500 3600 3700 3800 3900 4000 4100 4200 4300 4400 4500 4600 4700 4800 4900 5000 5100 5200 5300 5400 5500 5600 5700 5800 5900 6000 6100 6200 6300 6400 6500 6600 6700 6800 6900 7000 7100 7200 7300 7400 7500 7600 7700 7800 7900 8000 8100 8200 8300 8400 8500 8600 8700 8800 8900 9000 9100 9200 9300 9400 9500 9600 9700 9800 9900 10000

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J. G. HARRISON, Surveyor-General,
at the Government Office

quently speak at greater length, have turned their attention to photo-lithography.

It is not my intention to undertake the description and criticism of the majority of these important inventions, save as far as they stand in close relationship to the subject of this paper. The invention I have been fortunate enough to make belongs to the latter class, and I shall describe it as concisely as possible, and then proceed to compare its capabilities with other photo-lithographic methods.

To prevent misconception, it may perhaps be well to state that the manipulations I am about to describe are only such as aid the lithographer in producing one particular kind of work, namely that which is printed from smooth stones. My process, in the form I shall give it in this paper, is chiefly applicable to the reproduction of drawings formed of hard defined lines, such as maps, pen and ink sketches, and important documents; and less so to photographic views of landscapes, portraits, or indian ink drawings, composed of tints and shades; and although the former class may not be as interesting and attractive a study as the latter, yet I believe it to be of equal, if not superior, practical value. Circumstances have caused me to turn my attention more particularly to the reproduction of maps and plans, and I wish it to be understood that my remarks on this occasion bear reference to that description of work.

It is generally the case that the scale on which a map is drawn by the surveyor of a district is very much larger than that which would be wisely selected for publishing his map; inasmuch as the details become too minute and tedious, and would take him more time than should be expended upon one copy, if he were to draw upon the usual publishing size; the consequence is that his plan must be reduced before it is engraved or drawn upon stone. This process of reduction is more or less troublesome as the map contains more or less work, when it is accomplished in the old way; but by photographic means it is a matter of the utmost indifference whether the original be crowded or not. The application of photography to reducing maps was introduced into the Ordnance department of Great Britain, in the year 1855, by Colonel James, with perfect success.

To proceed a step further, and imprint such a reduction directly upon the stone in such a way that common lithographs can be printed from it, is the problem the photo-lithographer has to solve.

Without entering too minutely upon a description of the manipulatory details peculiar to my process, I shall simply give a concise account of the several operations, so far as they are of scientific interest.

In the first instance a sheet of paper is prepared with albumen in the usual way known to photographers; it is, when quite dry, passed through a copperplate or lithographic press, upon a polished steel or copper plate, by which operation it receives a very smooth and regular surface; it is then coated on the same side with a solution of gelatine, to which an addition of bi-chromate of potash has been made; this is then carefully dried in the dark, and again passed through the press to ensure the finest surface. This operation completes the preparation of what I shall call the sensitive paper. Having made a negative of the original map bearing the desired proportions to it, I place a suitable piece of the sensitive paper, just described, under and in close contact with the map, and the whole is exposed to daylight in such a way that the luminous influence passing through the transparent parts of the negative, shall strike directly upon the prepared surface, while the greater part of the paper is protected from its influence by the dark parts of the negative, which correspond to the white places on the original map. In the presence of the organic matter, the actinic agency effects the decomposition of the bi-chromate of potash, and the liberated nascent oxygen in all probability re-acts upon the gelatine, altering its chemical characteristics in a peculiar manner. The visible effect after removing the negative is the formation of a picture in brown upon the clear yellow of the paper, corresponding to the transparent portions of the negative, or to the black lines upon the original drawing.

This positive photographic print is next covered with an even coating of lithographic transfer ink, by passing it through the press face downwards upon an inked-in lithographic stone; the pressure causes the whole of the sensitive surface to lay hold of the ink, and bear away with it an even coating, hiding the brown photographic positive from view. The altered parts of the gelatine which have been exposed to the luminous action appear to be possessed of a certain amount of affinity for the grease of the ink, so that they will be found to retain it with considerable tenacity.

The next operation is to coagulate the albumen which still exists under the prepared surface; this is done by floating it upon boiling water, with the paper-side downwards. A

subsequent soaking for a short time causes the unaltered gelatine to swell in such a way as to raise the ink with it from the paper, and a slight amount of friction, with a sponge or other soft substance, removes the superfluous ink from all parts of the inked print which correspond to the white parts upon the original document. When the lines all appear clear and well defined, boiling water is poured over the whole, to remove the last traces of gelatine, and the print is dried. We are now possessed of a *bona-fide* lithographic transfer—that is a drawing in greasy ink of such a nature that it admits of being transferred to the stone in the ordinary manner, by simply inverting it thereon, and passing it through the press; the albumen, which will be found to have withstood all the washing, acting as the adhesive substance under the ink to prevent the paper slipping on the stone.

The whole of these operations need not occupy more than from two to three hours.

Having now given a description of the leading features of my process, allow me to offer a few critical remarks upon those of others, having the same or similar ends in view, prefacing them with some observations on the possible means of obtaining the photo-lithographic image.

While endeavouring to produce a delineation or drawing upon lithographic stone, from which impressions can be printed on paper in the lithographic press, it must be borne in mind that the nature of such a delineation is what may be styled “a reversed positive”—a positive, inasmuch as the lines and shades are represented by similar lines and shades upon the stone—and reversed, because those parts, which on the finished print appears on the right hand, are to the left on the stone, and *vice versa*. Whatever means the operator may adopt, his ultimate object is to produce a drawing of this nature.

In calling in the help of photography, the lithographer will find that there are but three obvious ways in which the agency of light can be used to aid him in producing a delineation upon a surface made sensitive to its chemical action.

1st. The exposure of such a surface in the camera.

2nd. Its exposure under a negative which has been made in the camera; or

3rd. Its exposure under a positive, produced from such a negative.

Let us now examine the circumstances which attend the application of each of these three methods in photo-litho-

graphy, when the sensitive surface which is to receive the impress of light in the first instance, and afterwards to retain the greasy ink forming the picture, is spread upon the stone itself. In explanation of my reasons for making this examination, I may state that, as far as I can learn, all the efforts which have been made to produce lithographs by photographic means have been expended directly upon the stone itself, and not, as in my own process, upon a chemically prepared transfer paper.

Firstly, Exposure in the Camera.

The exposure of the lithographic stones in the Camera is a very difficult matter, owing to their varying dimensions, their weight and bulk, and the serious difficulty which the endeavour to make the surface of the stone coincide, as regards position, with that of the ground glass side of the camera, gives rise to. As long as we adhere to this method of exposure, the cumbersome nature of the stones excludes the application of photo-lithography to the reproduction of landscapes altogether. It will also be seen that a sensitive surface being exposed in this way must subsequently take the ink upon the parts which have *not* been acted upon by light; in other words, upon those parts of the stone corresponding to the unaltered portions of the said "surface."

Secondly, Exposure under a Negative.

This is the most obvious, and the most convenient means of attaining the end we have in view; but if we work with a "sensitive surface" upon the stone itself, there are several difficulties which present themselves. A negative, to possess the sharpness from which good results may be obtained, must be made upon glass, either by the collodion or albumen process; such a negative is, when taken in the usual way, a "reversed negative;" this when placed upon the stone, will give a "direct positive" photographic delineation, and a stone so prepared will give in the press "reverse positive" prints; that is, prints of a nature utterly useless, except perhaps in the case of portraits. To overcome this difficulty either the collodion film must be taken off the glass and turned upon the stone, or the glass with the sensitive film upon it must be turned in the camera, when making the negative, and the rays of light allowed to shine through the glass plate, striking the sensitive film on its inner surface; the inconvenience which both these alternatives occasion is very great, and very apparent; they are however, both perfectly feasible, although deficient in certain minor particulars

into which I shall not enter. In using glass negatives on stone, we encounter another, and an almost insurmountable obstacle, when the stone exceeds a very moderate size; namely, the difficulty of ensuring intimate and perfect contact between all parts of the two rigid surfaces. A sensitive surface exposed in this way receives the ink upon its sunned or altered parts.

Thirdly, Exposure under a Positive.

Some of the disadvantages of the previous method of producing the photographic image which is to take the ink, are obviated by having recourse to exposure under a positive; others again of a very serious nature are superadded. The rigidity of the glass is avoided if we use a paper positive, but one of this kind is not nearly so positive in reference to transmitted light as we would suppose, when looking at it with reflected light; that is, the contrast is not so great between the quantity of light which passes through the black and the white parts of such a print, and is greatly inferior to the contrast in the quantity of light which passes through the transparent and opaque parts of a good intense negative. Real positives can be prepared upon glass, coated with albumen of a very intense character, but the manipulations are troublesome, and would not be adopted save in cases of necessity. Exposure under a positive is tantamount to exposure in the camera, and the surface so treated must take the ink upon the unsunned parts.

I shall now enumerate the several photo-lithographic processes of which I have been able to gain any information. M. Lamercier, in 1853, and Mr. Macpherson, in 1856, have published processes almost in every respect identical; they both assure us of very successful results, as far as drawings showing a "grain" are concerned, that is in a style suitable for landscapes and portraits, but indifferently adapted for maps, plans, music, &c., &c. The "sensitive surface" they use is formed on the stone by running a sort of varnish, made of asphaltum, over it, and the exposure is accomplished under a common negative. The circumstances which have prevented their methods coming into general use are, no doubt, chiefly the following:—

1st. Great irregularity and uncertainty in the photo-chemical constitution of each different sample of asphaltum.

2nd. The expense caused by the extravagant use of ether, large baths of which are required, in which to dip and soak the face of the stones.

3rd. The utter impossibility of timing the exposure, which, if not done exactly, occasions the loss of a great deal of time and chemicals, and obliges the operator to begin again.

4th. The reverse nature of every impression produced, the result of working from a common negative.

M. Poitevin, in the year 1856, patented a process based upon the alterative action of light on gelatine or gum when associated with bi-chromate of potash. The stone, or other material prepared to receive the design, has its surface covered with a layer, produced by running over it a solution of gelatine, or some such substance, in conjunction with bi-chromate of potash, and is then exposed to the action of light "in the camera, under a negative, or under a positive." After exposure it is wetted with water, and the lithographic ink rolled in, which attaches itself only to the parts acted upon by light, inasmuch as they remain dry and unaffected by the water; it is from this inked surface that impressions can be multiplied in the press.

The description of this process as given in M. Poitevin's specification, is exceedingly vague, diffuse, and contradictory, I believe designedly so—an opinion supported to some extent by a statement made by Mr. Malone, at a meeting of the Photographic Society, London, December 7, 1858, two years and eight months after date of patent (see *Photographic Journal*, Dec. 11, 1858, page 93); after stating that M. Poitevin was working on stone, and that he (Mr. Malone) saw him expose a stone in his garden at Paris, he says, "I observe that he keeps the secret to himself," but taking M. Poitevin's process as it stands in his specification, it is subject to the following critical remarks, viz. :—

1st. If he exposes in the camera, or under a positive, as he suggests, he will, as he himself tells us, produce a negative picture on the stone, the use of which it is impossible to conceive.

2nd. If he exposes under a negative in the way he describes, he will produce a "direct positive" on the stone, and a reversed positive on the printed impressions, which are useless, save in the case of portraits of an inferior description.

3. In any case the delineation on the stone, or other surface from which he prints, will wear out, and give only a few impressions, owing to the film of altered gelatine which exists between the stone and the ink, not resisting the combined effects of water, and the pressure and friction of the press, a fact strongly commented on by Mr. Pouncy, at the

meeting of the London Photographic Society, January 4th, 1859 (see *Photographic Journal*, Jan. 8th., 1859).

4th. In consequence of his manner of wetting the whole gelatinous surface before applying the ink, he increases the difficulty of getting the ink to adhere to the altered parts of the coating; by smearing them with semi-dissolved gelatine, he deteriorates the quality of the ink which does adhere, and the ultimate result will be rotten lines.*

Mr. W. G. Newton has taken a patent for photo-lithography, a detailed copy of which is given in the *Photographic Journal* for Nov. 22nd, 1858; this gentleman prepares his stone or zinc plate in a manner very similar to M. Poitevin; he exposes in the camera, or under a positive, and the result is that he has to use the altered insoluble parts of the gelatinous surface, not as points of attraction for the ink, but as a means of protecting the stone while he removes and inks in the unaltered portions; this method obliges him, 1st, if he wants to get the best results, to expose in the camera, if not to use a positive on paper, or a real positive on albumenized glass, all three methods of exposing having many disadvantages. 2nd. Inasmuch as he uses for the boundary of his lines that section of the gelatinous surface which is in contact with the stone, not that on which the picture is impressed by the luminous rays, he can never obtain the sharpest definition.

With these objections I believe his process to be sound in theory, and by it he may produce good results as far as landscapes and portraits are concerned, but not so when the copy of a map, or any other design composed of and bounded by hard dense lines, is required.

M. Jobart, in a communication to the Academy of Sciences of Paris, has intimated his discovery of a photo-lithographic process, based upon principles differing totally from the foregoing, namely, some peculiar action exerted by iodide of silver upon gum arabic. The only notice of his invention I have been able to procure, is in the *Athenæum* for Feb., 1859, where the description of it is too indistinct and sketchy to admit of any criticism.

* Since the above was written I have met with the following statement in the *Illustrated London News*, Jan. 22nd, 1859, p. 33 :—

“* * * Certain patents taken out in Dec. 1855, by M. Poitevin, for photo-lithographic and carbon printing (Nos. 2815 and 2816), have just lapsed, the renewal fees not having been paid on them.”

J. W. O.

I now come to my own process, which, judging as fairly as I can, I believe to be superior to all others, and perfectly distinct and new. I rest its superiority on—

1st. Its simple and thoroughly practical character, in virtue of which it can be easily learned and executed.

The utter absence of all specimens of Photo-lithography in this country, save my own, tends to show that processes which have been patented in other countries three or more years ago, either do not pay in the working, or are too difficult, intricate, or imperfect in their details, to admit of being advantageously carried out.

2nd. I produce by photographic means, a *bona fide* “transfer” in its technical sense, on lithographic paper, in lithographic ink, from which the image is conveyed to the stone by the well-known process of transferring, in such a way that it then becomes a genuine lithographic drawing, differing in no one respect from those produced in the ordinary way, and subject to all the operations and manipulations practised by the lithographic printer; the ink is not *on* the stone, separated by any interposed substance, but *in* it, as it ought to be; the stone will not wear in the press, or the quality of the drawing suffer by any number of impressions short of 2000 or 3000.

3rd. My process gives direct results, working as I do from a common negative which may have been prepared anywhere, at any time, or by any person; I form on the photo-lithographic transfer paper a “direct positive,” in lithographic transfer ink; this, by being impressed upon the stone, gives a “reverse positive,” from which direct prints may be thrown off in the press.

4th. By using transfer paper I overcome all the numerous difficulties which arise from having to expose a stone in the camera, or from having to expose it under a positive or negative. I exclude stones altogether from the photographic laboratory, and all cumbersome apparatus appertaining thereto. Besides which, the facility with which a piece of paper can be exposed under a negative is very great; from its flexible nature the most intimate contact can be established between the two, whereby the most minute details are obtainable, and the operator can with perfect safety examine the paper from time to time in the ordinary way, and stop when the change of color is sufficient.

5th. That part of the photographic picture which in my process takes the ink, is on that surface of the sensitive

gelatine which is first struck by the luminous rays ; namely, that surface which is in contact with the negative, and the lines and dots forming the picture are bounded by a section made through that surface, and not through that which is in contact with the stone, or other material on which the gelatine is spread, whereby I produce the utmost sharpness of definition.

6th. I can prepare a stock of sensitive gelatinous papers, which will keep for a considerable time, ready for use at any moment ; whereas when stones are used they must be severally prepared when wanted.

7th. One most important peculiarity in which my process surpasses all others is involved in my method of inking. Other operators (M. Poitevin for example) who have used gelatine, after having exposed the sensitive surface, proceed by wetting it before applying the ink, with a view to keep the unaltered portions free from ink ; the consequence of which is a part of the gelatinised surface is rubbed over the altered parts which represent the drawing, making them refuse to take the ink, or only to do so with difficulty ; and the quality of the ink, and by consequence that of the lithograph, is very much injured ; whereas I ink-in, covering the whole surface of the photographic print while dry, before the swelling of the unaltered gelatine has depressed the positive portions of the print, and trust to the subsequent washing processes to remove the gelatine, and with it the ink from those parts which ought to be clean and white.

8th. The method I have adopted of applying the ink in the press cannot I believe, be surpassed ; it gives the greatest regularity and accuracy as to quantity, and aids the affinity which exists between the altered gelatine and the ink, by the force with which it is applied.

9th. The coating of albumen on the paper which precedes that which I apply of gelatine, is also of the greatest value, and its adoption is completely original. The solubility of dried albumen causes the albuminised surface to unite intimately with that of gelatine during the manufacture of the paper, and the readiness with which this, under coating of albumen, can afterwards be coagulated, by simply floating it upon hot water, thereby rendering it no longer soluble in water, enables a sufficiently glutinous surface to be retained under the inky-print when finished, to establish the important property which the "transfer" must possess of adhering to the stone during the operation of transferring.